AMENDMENT TO THE CLAIMS

Claims 1-49 (Cancelled)

50.(New)   An audio signal band extending apparatus comprising:

a noise generating device for generating a noise signal level-correlated to and so as to change according to one of a level of an inputted signal and a level of a signal in a partial band obtained by bandpass-filtering the inputted signal using a bandpass filtering device;

a signal processing device for multiplying a generated noise signal by a predetermined transfer function so that, at a lower limit frequency of a predetermined band-extended signal, a level of the generated noise signal substantially coincides with the level of the inputted signal and a spectral continuity thereof is kept when addition is executed by an adding device, and for outputting a signal having a multiplication result; and

an adding device for adding up the inputted signal and an outputted signal from said signal processing device, and for outputting a signal having an addition result,

wherein said noise generating device comprises:

a level signal generating device for detecting a level of a signal inputted to said noise generating device, and for generating and outputting a level signal having a detected level;

a noise signal generating device for generating and outputting a noise signal

according to the signal inputted to said noise generating device; and

a multiplying device for multiplying the level signal from said level signal

generating device by the noise signal from said noise signal generating device, and for

outputting a noise signal having a multiplication result.

51.(New)   An audio signal band extending apparatus comprising:

a noise generating device for generating a noise signal level-correlated to and

so as to change according to one of a level of an inputted signal and a level of a signal

in a partial band obtained by band pass-filte ring the inputted signal using a bandpass

filtering device;

a signal processing device for multiplying a generated noise signal by a

predetermined transfer function so that, at a lower limit frequency of a predetermined

band-extended signal, a level of the generated noise signal substantially coincides with

the level of the inputted signal and a spectral continuity thereof is kept when addition is

executed by an adding device, and for outputting a signal having a multiplication result;

and

an adding device for adding up the inputted signal and an outputted signal from

said signal processing device, and for outputting a signal having an addition result,

wherein said noise generating device comprises:

a first cutting-out device for cutting out predetermined higher-order bits from the signal inputted to said noise generating device, and for outputting a signal including the higher-order bits;

at least one second cutting-out device for cutting out at least one of predetermined intermediate-order bits and predetermined lower-order bits from the signal inputted to said noise generating device, and for outputting a signal including the at least one of the predetermined intermediate-order bits and predetermined lower-order bits; and

a multiplying device for multiplying a signal from said first cutting-out device by a signal from said second cutting-out device, and for outputting a noise signal having a multiplication result.

52.(New)   An audio signal band extending apparatus comprising:

a noise generating device for generating a noise signal level-correlated to and so as to change according to one of a level of an inputted signal and a level of a signal in a partial band obtained by band pass-filtering the inputted signal using a bandpass filtering device;

a signal processing device for multiplying a generated noise signal by a predetermined transfer function so that, at a lower limit frequency of a predetermined band-extended signal, a level of the generated noise signal substantially coincides with the level of the inputted signal and a spectral continuity thereof is kept when addition is

executed by an adding device, and for outputting a signal having a multiplication result; and

an adding device for adding up the inputted signal and an outputted signal from said signal processing device, and for outputting a signal having an addition result,

wherein said noise generating device comprises:

a non-uniformity quantization device for quantizing a signal inputted to said noise generating device non-uniformly relative to a level thereof, and for outputting a resultant signal;

a dequantization device for executing a processing opposite to a processing executed by said non-uniformity quantization device on a signal from said non-uniformity quantization device, and for outputting a resultant signal; and

a subtraction device for generating and outputting a quantized noise signal of the signal inputted to said noise generating device by calculating a difference between the signal inputted to said noise generating device and a signal from said dequantization device.

53. (New)   The audio signal band extending apparatus as claimed in claim 50, further comprising:

a first conversion device provided so as to be inserted at the previous stage of said bandpass filtering device, said first conversion device converting the inputted signal into a digital signal; and

a second conversion device provided so as to be inserted between said signal processing device and said adding device, said second conversion device converting the outputted signal from said signal processing device into an analog signal.

54. (New)   The audio signal band extending apparatus as claimed in claim 50, further comprising:

an oversampling type low-pass filtering device provided so as to be inserted at the previous stage of said bandpass filtering device and said adding device, said oversampling type low-pass filtering device oversampling and low-pass filtering the inputted signal, and outputting a resultant signal to said bandpass filtering device and said adding device.

55. (New) The audio signal band extending apparatus as claimed in claim 50, further comprising:

an oversampling type low-pass filtering device provided to be inserted at the previous stage of said adding device, said oversampling type low-pass filtering device oversampling and low-pass filtering the inputted signal, and outputting a resultant signal to said adding device; and

an oversampling device provided to be inserted between said noise generating device and said signal processing device, said oversampling device oversampling the

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noise signal from said noise generating device, and outputting a resultant signal to said signal processing device.

56.(New)   The audio signal band extending apparatus as claimed in claim 50, wherein said noise signal generating device comprises a delta sigma modulator type quantizer, generates a quantized noise signal of a signal inputted to said noise signal generating device, and outputs a generated quantized noise signal as the noise signal.

57.(New)   The audio signal band extending apparatus as claimed in claim 51, wherein said second cutting-out device cuts out either one of a combination of intermediate-order bits and lower-order bits, and two intermediate-order bits, at different bit locations and with a predetermined bit width, adding up cut out bits, and outputs a signal having an addition result.

58.(New)   The audio signal band extending apparatus as claimed in claim 51, wherein said second cutting-out device cuts out either one of a combination of intermediate-order bits and two lower-order bits, and three intermediate-order bits, at different bit locations and with a predetermined bit width, adding up cut out bits, and outputs a signal having an addition result.

59.(New)   The audio signal band extending apparatus as claimed in claim 51,

further comprising:

an independent noise generating device for generating a noise signal

independent of the inputted signal; and

a further adding device for adding up the noise signal from said second cutting-out

device and the noise signal from said independent noise generating device, and for

outputting a signal having an addition result to said multiplying device.

60.(New)   The audio signal band extending apparatus as claimed in claim 59,

wherein said independent noise generating device generates a plurality of noise

signals different from each other, adds up said plurality of noise signals, and outputs a

signal having an addition result.

61. (New)   The audio signal band extending apparatus as claimed in claim 59,

wherein said independent noise generating device generates a diamond

dithering noise signal.

62.(New)   The audio signal band extending apparatus as claimed in claim 52,

wherein said non-uniformity quantization device quantizes an inputted signal so

as to increase a quantization width as a level of the inputted signal is larger.

63. (New)   The audio signal band extending apparatus as claimed in claim 52,

wherein said non-uniformity quantization device compresses a run length of a

linear code of L bits into 1/N thereof so as to generate and output data of M bits, where

L, M and N are positive integers each of which equals to or larger than 2.

64. (New)   The audio signal band extending apparatus as claimed in claim 52,

wherein said non-uniformity quantization device converts a linear code of L bits

that consists of continuous data Q0 of continuous bits each having a predetermined

logic and being allocated in a higher order part, an inverted bit T0 that breaks

continuity of the continuous data Q0, and lower-order data D0 following the inverted bit

T0, into compressed data of M bits consisting of compressed continuous data Q1

obtained by compressing a run length of the continuous data Q0, an inverted bit T1 for

that breaks continuity of the compressed continuous data Q1, compressed residual

data F1 representing a residue generated upon compressing the run length, and

mantissa data D1 obtained by rounding the lower-order data D0, and outputs the

compressed data of M bits, and

wherein, provided that the run length of the continuous data Q0 is L0, a run

length of the compressed continuous data Q1 is L1, and that N is an integer equal to or

larger than 2, the run length L1 of the compressed continuous data Q1 and the

compressed residual data F1 are expressed by L1 = Int (L0/ N) and F1 = L0 mod N,

respectively, where Int is a function that represents an integer value of an argument, and A mod B is a function that represents a residue obtained when A is divided by B.

65. (New) The audio signal band extending apparatus as claimed in claim 52,

wherein said dequantization device extends a compressed data that consists of compressed continuous data Q1 of continuous bits each having a predetermined logic and being allocated in a higher-order part, an inverted bit T1 that breaks continuity of the compressed continuous data Q1, compressed residual data FI representing a residue generated upon compressing a run length of the compressed continuous data Q1, and a mantissa data D1, by extending the run length of the compressed continuous data Q1 by "N" times, adding continuous data having a length corresponding to a value of the FI, adding an inverted bit TO that breaks continuity of Q0, further adding the mantissa data D1 to a resultant data, reading out the continuous data Q0, the inverted bit T0, and the mantissa data DO, and outputting an extended data, and

wherein, provided that a run length of the continuous data Q0 is L0, a run length of said compressed continuous data Q1 is L1, a residue obtained from the compressed residual data F1 is F1, and N is an integer equal to or larger than 2, the run length L0 and the mantissa data D0 are expressed by $L0 = L1 * n + F1$ and $D0 = D1$, respectively, where * is an arithmetic symbol representing multiplication.

66. (New) The audio signal band extending apparatus as claimed in claim 52,

wherein said non-uniformity quantization device floating-encodes an inputted

linear code into a floating code having a predetermined effective bit length, and outputs

an encoded signal having the floating code.

67. (New) The audio signal band extending apparatus as claimed in claim 50,

wherein said noise generating device comprises:

a table memory device for storing a relationship between the signal inputted to

said noise generating device and a noise signal level-correlated to the signal inputted

to said noise generating device so as to change according to a level of the signal

inputted to said noise generating device; and

a conversion device for, responsive to the signal inputted to said noise

generating device, reading out and outputting a noise signal corresponding to the

signal inputted to said noise generating device from said table memory device.

68. (New) The audio signal band extending apparatus as claimed in claim 50,

wherein said signal processing device comprises at least a first filtering device,

and wherein said signal processing device filters out frequency bands higher than a

frequency band of the inputted signal.

69. (New) The audio signal band extending apparatus as claimed in claim 50,

wherein said signal processing device comprises at least a (1/f) filtering device, and

wherein said signal processing device applies a (1/f) reduction characteristic to a higher frequency band spectrum of the signal inputted to said signal processing device.

70. (New) The audio signal band extending apparatus as claimed in claim 50,

wherein said signal processing device comprises at least an echo adding processing device, and

wherein said signal processing device adds an echo signal to a higher frequency band spectrum of the signal inputted to said signal processing device.

71. (New) The audio signal band extending apparatus as claimed in claim 50,

wherein said signal processing device comprises at least a second filtering device, and

wherein said signal processing device filters out frequency bands higher than a frequency band of the signal inputted to said signal processing device so as to include frequency bands exceeding a Nyquist frequency.